

Research Article

The Use of Parsimonious Questionnaires in Occupational Health Surveillance: Psychometric Properties of the Short Italian Version of the Effort/Reward Imbalance Questionnaire

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Purpose. To perform a parsimonious measurement of workplace psychosocial stress in routine occupational health surveillance, this study tests the psychometric properties of a short version of the original Italian effort-reward imbalance (ERI) questionnaire.

Methods. 1,803 employees (63 percent women) from 19 service companies in the Italian region of Latium participated in a cross-sectional survey containing the short version of the ERI questionnaire (16 items) and questions related to self-reported health, musculoskeletal complaints and job satisfaction. Exploratory factor analysis, internal consistency of scales and criterion validity were utilized.

Results. The internal consistency of scales was satisfactory. Principal component analysis enabled to identify the model’s main factors. Significant associations with health and job satisfaction in the majority of cases support the notion of criterion validity. A high score on the effort-reward ratio was associated with an elevated odds ratio (OR = 2.71; 95% CI 1.86–3.95) of musculoskeletal complaints in the upper arm.

Conclusions. The short form of the Italian ERI questionnaire provides a psychometrically useful tool for routine occupational health surveillance, although further validation is recommended.

1. Background

Work-related stress is one of the leading causes of workers’ ill health in developed countries [1], where it has considerable effects on sickness absence and disability [2]. Epidemiological investigations document significant associations of stressful work with coronary heart disease [3–5], depression [6–8], musculoskeletal disorders [9, 10], and other stress-related health problems [11]. In recent years, specific theoretical concepts and their measurement in terms of psychometrically validated standardized questionnaires has led to progress in identifying psychosocial working conditions that produce adverse health effects.

Occupational epidemiological research has focused on two such concepts: the “demand-control” model and the “effort-reward imbalance” model. The former assumes that job task profiles characterized by high psychological demands and a low level of control and decision latitude are stressful [12, 13], whereas the latter is concerned with stressful features of the work contract resulting from failed reciprocity between (high) efforts spent and (low) rewards received [14, 15]. In this model, three types of rewards are important: money, esteem, and career, including job security. Moreover, in addition to extrinsic effort this model assesses a distinct personal pattern of coping with job demands, termed overcommitment. According to this theoretical approach, workers who experience high effort, low reward, and a mismatch between them (high cost-low gain), and workers who exhibit a high level of overcommitment are susceptible to an elevated risk of stress-related disorders.
The two models complement each other, and some evidence indicates that the former concept is of particular use in industrial workers, whereas the latter may be more appropriate in the tertiary sector [16, 17]. In several countries, including Italy, routine assessment of psychosocial stress at work has become compulsory for occupational health services. Therefore, short, validated, and easily applicable questionnaires are needed to assess the prevalence of work-related stress as a basis for potential preventive efforts. A few years ago, a short version of the original questionnaire used to measure the effort-reward imbalance (ERI) model [14, 15] was developed and tested in a German [18] and a Swedish [19] sample of male and female workers. We set out to conduct a psychometric test of the short version of the original Italian questionnaire [20] in a large sample of male and female employees in Italy. More specifically we aim at replicating its construct validity and analyzing its association with job satisfaction, musculoskeletal complaints, and self-rated health.

2. Methods

In 2010, workers undergoing regular health surveillance in the workplace under the responsibility of the first author were asked to complete an anonymous questionnaire composed of three sections: (1) basic socio-demographic information (restricted to gender and age to ensure anonymity); (2) musculoskeletal disorders, general health and job satisfaction; (3) the short version of the ERI questionnaire. As mentioned, health surveillance is mandatory in Italy for workers exposed to occupational hazards, yet assessment procedures are flexible, thus, allowing some innovation—in our case the administration of the short ERI questionnaire. Workers who had been employed for at least one year in the same workplace were eligible (see sample description below). The study was approved by the Ethics Committee of the Catholic University of Sacred Heart.

Musculoskeletal complaints were assessed by the Nordic questionnaire [21]. Participants were asked to assess (1) if they had had problems (pain, ache, discomfort) at any time during the previous 12 months (recurrent symptoms); (2) if they had had problems during the previous 7 days (persistent symptoms); (3) if they were experiencing problems at the time of the medical examination (active symptoms). Those who gave a positive response were requested to specify in which of 9 parts of the body (neck, shoulders, elbows, wrist and hands, upper back, low back, hips and thighs, knees, ankles, and feet) they had experienced health problems. All items are binary, with the category “yes” defining presence and “no” defining absence of musculoskeletal symptoms. The questionnaire provides information about one-year prevalence and the point prevalence of musculoskeletal complaints.

General self-rated health was measured by the one-item question: “How would you rate your general state of health?” Respondents answered on a scale from 1 to 5 ranging from 1 “I’ve serious health problems” to 5 “I’ve very good health.”

Job satisfaction was measured by a single item of the scale proposed by Warr et al. [22]: “How do you feel about your job as a whole?”. Respondent answered on a scale ranging from 1 “I’m extremely dissatisfied” to 7 “I’m extremely satisfied.”

Effort, reward, and overcommitment were measured by the short version of the ERI questionnaire where effort is measured by three questions, reward by seven questions, and overcommitment by six questions [18]. All respective items were answered on a four-point Likert scale (ranging from 1 “strongly agree” to 4 “strongly disagree”). Total scores of these ratings were calculated with appropriate recoding, so that high scores reflect high effort, high reward and high overcommitment. Thus, the range of effort scale is 3–12, of the reward scale is 7–28, and of the overcommitment scale is 6–24. Additionally, an effort-reward ratio was calculated by dividing the score of “effort” by the score of reward, adjusted for unequal number of items. This was done in order to quantify the degree of mismatch between effort and reward at individual level.

2.1. Sample. This voluntary survey was offered to all male and female workers from 19 different service companies who had been employed there for more than one year. Overall, 1,803 subjects (669 male, 37%, 1,134 female workers, 63%) completed the questionnaire and were included in the analysis. The response rate ranged from 89% to 100% (average: 95.3%). Given the high response rate there was no indication of selection bias. Workers were employed in health care services (n = 998, 55.4%), social services (n = 395, 21.9%), retail (n = 281, 15.6%), and financial services (n = 129, 7.1%) (Table 1).

2.2. Statistical Analysis. An exploratory factor analysis, with principal component extraction and varimax rotation method with Kaiser normalization was used to test the psychometric characteristics of the scales of the ERI short questionnaire. To identify the scales, we adopted the criteria that item loading should be greater than .50 on the loading factor and at least .20 above that for any other factors, thus, indicating that the item was conceptually distinct [23]. The resulting factor structure was compared to the original construct of the German version. Reliability of each subscale was calculated with the Cronbach’s alpha statistic.

We tested some aspects of criterion validity of the short ERI version assuming that employees who scored high on the scales of the construct were at elevated risk of experiencing poor self-rated health and poor job satisfaction, compared to those with lower scores. The associations between exposure variables and outcomes were examined by multiple linear regression analysis. After first calculating an unadjusted model, we subsequently adjusted for age and gender, entering effort, reward and overcommitment as independent variables. We then repeated the same steps entering effort-reward ratio as an independent variable.

Finally, the association between exposure variables and musculoskeletal complaints was investigated by logistic regression analysis. First we calculated an adjusted model, and then we adjusted it for age and gender. Odds ratios and confidence intervals at 95% were calculated. We used version 15.0 of SPSS for Windows for the statistical analyses.
3. Results

3.1. Psychometric Properties. The factor analysis identified four factors that accounted for 53% of the total variance. After rotation, each factor was seen to correspond to a specific construct, as in the original version (Table 2). The first factor corresponded to the “overcommitment” scale, the second one to the “effort” scale, and the last two factors to the “reward” construct. The subdivision of “reward” into two factors, although already observed in a previous Italian study based on the original 23-item questionnaire [20], did not conform to the theoretical assumption of three subcomponents. Although “job security” was well replicated, there was no clear distinction between “esteem” and “salary, career prospects.” It seems that the items measuring non-monetary rewards (esteem) and those measuring monetary and status-related rewards “status” did not cluster in two separate factors. Almost all items showed significant factor loadings (>0.50) on the factor corresponding to their construct, and negligible loading (<0.20) on other factors; only two items pertaining to the “overcommitment” scale (oc1 and oc4) had loadings inferior to .50 on their factor, but their loadings on other scales were negligible, thus, providing evidence of their specificity.

Using factor analysis, we composed 4 scales (“effort,” “job security,” “esteem and status,” “overcommitment”) and calculated their internal consistency. Cronbach’s alpha coefficients were 0.72 for “overcommitment”, 0.69 for “effort”, 0.68 for “esteem and status”, and 0.63 for “job security”, suggesting satisfactory internal consistency in view of the small number of items (Table 2). Item-total correlations coefficients (corrected) varied between 0.34 and 0.61 and were all above the threshold of 0.30 [24], indicating considerable consistency between items defining respective scales. Using the theoretical model, we constructed a general “reward” scale based on the two subscales, and a ratio of “effort” and “reward” was defined according to established procedures [15]. Thus, in further analyses that tested associations with health and job satisfaction, four explanatory variables were included (“effort”, “reward”, “effort-reward ratio”, “overcommitment”).

3.2. Associations with Health and Job Satisfaction. Multiple regression analyses showed that the “effort”, “reward” and “overcommitment” scales’ were significantly related to self-rated general health. “Effort” had an inverse relationship, while “reward” and also “overcommitment” were positively related to the level of self-rated health. Correction for age and gender weakened the association between “effort” and health to some extent, while the relationships between “reward”, “overcommitment” and health remained unchanged. Low levels of “effort” and high levels of “reward” were significantly associated with low self-rated general health. “Effort” had an inverse relationship, while “reward” and also “overcommitment” were positively related to the level of self-rated health. Correction for age and gender weakened the association between “effort” and health to some extent, while the relationships between “reward”, “overcommitment” and health remained unchanged. Low levels of “effort” and high levels of “reward” were significantly associated with job satisfaction, whereas there was no evident association with “overcommitment”. Significant relationships were observed between the “effort-reward ratio” and self-rated health as well as job satisfaction. As illustrated in Table 3, scoring low on the “effort-reward ratio” was associated with high job satisfaction (Table 3).

Logistic regression analysis revealed that scoring high on “reward” decreased the probability of reporting low back pain at the time of the medical examination (OR = 0.87, 95% CI 0.84–0.90), while “overcommitment” was associated with an elevated odds ratio (OR = 1.16, 95% CI 1.11–1.20).
Table 2: Principal component analysis of ERI items with varimax rotation of factor loadings. The significant item loadings are highlighted by Bold.

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Mean (SD)</th>
<th>Components 1</th>
<th>Components 2</th>
<th>Components 3</th>
<th>Components 4</th>
<th>Item-total correlation coefficient (corrected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>eri1 ($)—I have constant time pressure due to a heavy work load</td>
<td>2.46 (.79)</td>
<td>−.149</td>
<td>.753</td>
<td>−.140</td>
<td>−.081</td>
<td>.547</td>
</tr>
<tr>
<td>eri2 ($)—I have many interruptions and disturbances while performing my job</td>
<td>2.64 (.82)</td>
<td>−.057</td>
<td>.727</td>
<td>−.139</td>
<td>−.071</td>
<td>.486</td>
</tr>
<tr>
<td>eri3 ($)—Over the past few years, my job has become more and more demanding</td>
<td>2.14 (.76)</td>
<td>−.098</td>
<td>.739</td>
<td>−.003</td>
<td>−.015</td>
<td>.498</td>
</tr>
<tr>
<td>eri4 ($)—I receive the respect I deserve from my superior or a respective relevant person</td>
<td>3.17 (.72)</td>
<td>.082</td>
<td>−.051</td>
<td>.702</td>
<td>−.024</td>
<td>.402</td>
</tr>
<tr>
<td>eri5—My job promotion perspectives are poor</td>
<td>2.48 (.89)</td>
<td>−.022</td>
<td>−.219</td>
<td>.173</td>
<td>.667</td>
<td>.408</td>
</tr>
<tr>
<td>eri6—I have experienced or I expect to experience an undesirable change in my work situation</td>
<td>2.72 (.76)</td>
<td>.108</td>
<td>−.170</td>
<td>.234</td>
<td>.717</td>
<td>.518</td>
</tr>
<tr>
<td>eri7—My job security is poor</td>
<td>2.68 (.81)</td>
<td>.077</td>
<td>.119</td>
<td>.071</td>
<td>.787</td>
<td>.396</td>
</tr>
<tr>
<td>eri8 ($)—Considering all my efforts and achievements, I receive the respect and prestige I deserve at work</td>
<td>2.79 (.72)</td>
<td>−.016</td>
<td>−.051</td>
<td>.791</td>
<td>.102</td>
<td>.540</td>
</tr>
<tr>
<td>eri9 ($)—Considering all my efforts and achievements, my job promotion prospects are adequate</td>
<td>2.62 (.71)</td>
<td>.030</td>
<td>−.027</td>
<td>.698</td>
<td>.306</td>
<td>.540</td>
</tr>
<tr>
<td>eri10 ($)—Considering all my efforts and achievements, my salary/income is adequate</td>
<td>2.19 (.77)</td>
<td>−.128</td>
<td>−.120</td>
<td>.546</td>
<td>.226</td>
<td>.385</td>
</tr>
<tr>
<td>oc1—I get easily overwhelmed by time pressure at work</td>
<td>2.65 (.71)</td>
<td>.305</td>
<td>−.556</td>
<td>.006</td>
<td>.091</td>
<td>.350</td>
</tr>
<tr>
<td>oc2—As soon as I get up in the morning I start thinking about work problems</td>
<td>2.76 (.83)</td>
<td>.686</td>
<td>−.233</td>
<td>−.034</td>
<td>.101</td>
<td>.539</td>
</tr>
<tr>
<td>oc3 ($)—When I get home, I can easily relax and “switch off” work</td>
<td>2.79 (.77)</td>
<td>.647</td>
<td>.069</td>
<td>.268</td>
<td>−.045</td>
<td>.360</td>
</tr>
<tr>
<td>oc4—People close to me say I sacrifice too much for my job</td>
<td>2.46 (.74)</td>
<td>.417</td>
<td>−.295</td>
<td>−.104</td>
<td>.068</td>
<td>.344</td>
</tr>
<tr>
<td>oc5—Work rarely lets me go, it is still on my mind when I go to bed</td>
<td>2.85 (.76)</td>
<td>.791</td>
<td>−.168</td>
<td>−.022</td>
<td>.016</td>
<td>.613</td>
</tr>
<tr>
<td>oc6—if I postpone something that I was supposed to do today I’ll have trouble sleeping at night</td>
<td>2.64 (.81)</td>
<td>.713</td>
<td>−.104</td>
<td>−.078</td>
<td>.043</td>
<td>.506</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Construct</th>
<th>Overcommitment</th>
<th>Effort</th>
<th>Reward-respect</th>
<th>Reward-career</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of variance explained by the scale</td>
<td>14.8%</td>
<td>14.1%</td>
<td>13.3%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Reliability (Cronbach’s alpha)</td>
<td>.72</td>
<td>.69</td>
<td>.68</td>
<td>.63</td>
</tr>
</tbody>
</table>

($) reversed score.
other studies [15, 18, 19, 25], but in keeping with a previous
tradicts previous findings demonstrating reduced rather
self-rated health and musculoskeletal complaints. This con-
Some noticeable exceptions.
While results in general support the hypothesis, there were
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further analyses of criterion validity. With this aim in mind, we
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eral health and two types of musculoskeletal complaints). While results in general support the hypothesis, there were
some noticeable exceptions.
First, “overcommitment” was positively associated with
self-rated health and musculoskeletal complaints. This con-
tradicts previous findings demonstrating reduced rather
than enhanced self-reported health among overcommitted
workers [18, 25, 26]. In the Italian sample, mean scores of
“overcommitment” were not very high, and this fact may
prevent the detection of adverse health effects. Secondly,
while all associations of “reward” with the criterion variables
are significant, there is an exception to this trend as regards
the “effort-reward ratio” (low back pain). On the other hand,
in accordance with the theoretical assumption, associations
with the ratio are generally stronger than those observed with
single scales of the model.

4. Discussion
This study was set up to test the psychometric properties
of the short version of the original questionnaire that mea-
sured occupational effort-reward imbalance in a convenience
sample of Italian workers. Data show satisfactory internal
consistency of these shortened scales, and exploratory factor
analysis supported the conceptual distinction between the
“effort” and “over commitment” scales. Contrary to most
other studies [15, 18, 19, 25], but in keeping with a previous
Italian investigation based on the original questionnaire
[20], we observed two (instead of three) subcomponents
of the construct “reward” as there was no clear distinction
between nonmaterial and material components of job-
related rewards. Although this result calls for further inves-
tigation, it may well be that it reflects the specific sample
composition of this study which was largely composed of
women working in health and social services where the
material and nonmaterial rewards of professional work are
often not separated as clearly as is the case in other branches
and sectors of the labor market.

Model fits derived from confirmatory factor analysis were
not tested, but in keeping with previous studies, a summary
“reward” scale and a ratio quantifying the mismatch between
ef fort and reward at individual level were constructed for
further analyses of criterion validity. With this aim in mind, we
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<table>
<thead>
<tr>
<th>ERI component</th>
<th>Self-rated general health</th>
<th>Job satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uncorrected B (P)</td>
<td>Corrected for age B (P)</td>
</tr>
<tr>
<td>Effort</td>
<td>−0.128 (P &lt; 0.001)</td>
<td>−0.07 (P &lt; 0.05)</td>
</tr>
<tr>
<td>Reward</td>
<td>0.192 (P &lt; 0.001)</td>
<td>0.198 (P &lt; 0.001)</td>
</tr>
<tr>
<td>Overcommitment</td>
<td>0.119 (P &lt; 0.001)</td>
<td>0.119 (P &lt; 0.002)</td>
</tr>
<tr>
<td>Effort/Reward</td>
<td>−0.273 (P &lt; 0.001)</td>
<td>−0.256 (P &lt; 0.001)</td>
</tr>
</tbody>
</table>

“Reward” (OR = 0.81, 95% CI 0.78–0.84) and “overcommit-
ment” (OR = 1.18, 95% CI 1.12–1.23) were associated in the
same way with upper limb disorders. Additional adjusting
for age and gender did not substantially change the results
(Table 4). Finally, the “effort-reward ratio” was significantly
related to upper limb disorders (OR = 3.37, 95% CI 2.34–
4.39), and this association remained significant after control
of confounding factors (OR = 2.71, 95% CI 1.86–3.95).

Table 3: Associations of the scales of the short effort-reward imbalance questionnaire with self-rated general health and job satisfaction (multiple regression analyses).
explaining work-related health risks it may be particularly useful for application in routine medical surveillance where parsimonious assessment has high priority.

Conflict of Interests

The authors declare that they have no competing interests.

Authors’ Contribution

N. Magnavita devised the study and collected and processed the data; J. Siegrist revised the statistical analyses and helped to draft the paper.

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References


Table 4: Associations of the scales of the short effort-reward imbalance questionnaire with acute low back pain and musculoskeletal problems at the upper arm (logistic regression analyses) (Odds ratios and 95% confidence intervals (CI)).

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted</th>
<th>Adjusted for age and gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds ratio</td>
<td>95% CI</td>
</tr>
<tr>
<td>Low back pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effort</td>
<td>0.94</td>
<td>0.88–1.00</td>
</tr>
<tr>
<td>Reward</td>
<td>0.87***</td>
<td>0.84–0.90</td>
</tr>
<tr>
<td>Overcommitment</td>
<td>1.16***</td>
<td>1.11–1.20</td>
</tr>
<tr>
<td>Effort/Reward ratio</td>
<td>1.10</td>
<td>0.83–1.45</td>
</tr>
<tr>
<td>Upper arm complaints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effort</td>
<td>1.10*</td>
<td>1.02–1.18</td>
</tr>
<tr>
<td>Reward</td>
<td>0.81***</td>
<td>0.78–0.84</td>
</tr>
<tr>
<td>Overcommitment</td>
<td>1.18***</td>
<td>1.12–1.23</td>
</tr>
<tr>
<td>Effort/Reward ratio</td>
<td>3.37***</td>
<td>2.34–4.39</td>
</tr>
</tbody>
</table>

*Significant at P < 0.05; **significant at P < 0.01; ***significant at P < 0.001.


